Chocolate Fat Extraction Using Supercritical fluids

Rudy Baskette, Supercritical Fluid Technologies, Inc.

Introduction

Dark chocolate bars consist of fat, sugar, and cocoa. In production, clean roasted cocoa beans are ground and stored in a hanging bag within a heated room. Cocoa fat drips down; the remaining bagged components are the cocoa powder solids. This is referred to as the Broma method. This cocoa fat is re-introduced with sugar to the cocoa powder in later stages to produce dark chocolate.

Recent reports state that consumption of dark chocolate, not milk or white chocolate, can promote heart health. Dark chocolate contains high levels of phenols, an antioxidant, that can deactivate free radicals in the blood, reducing blood pressure.

Nutritional information on the label of chocolate bars is not always accurate representation of the true caloric or fat content. It stands to reason that batches will vary in fat content to a certain extent.

SFT has developed a way to extract fat from processed dark chocolate bars to ensure chocolate quality control. This is also a method that could be modified to unprocessed cocoa beans or in cocoa slurries as a way to extract fat rather than the traditional Broma method detailed previously.

First, SFT determined the general solubility parameters of the chocolate in the SFT-Phase Monitor. The SFT-Phase Monitor allowed exploration of the ideal matrix of extraction conditions. The SFE conditions were optimized to obtain the highest yield fat fraction from dark chocolate. The extraction parameters were perfected using the SFT-110 SFE.

The SFT-110 SFE utilizes pressurized carbon dioxide to extract natural products. Carbon dioxide is advantageous over traditional extraction techniques because it does not introduce any residual organic chemicals, meaning that all chocolate fat extracts will be safe to consume. Supercritical carbon dioxide extraction is also a greener technology than steam distillation because it requires less heat to induce better final products. Following this method, the SFT-110 produces a natural, unaltered extract that gives food manufacturers a way to ensure quality control of their dark chocolate products as well as an alternative method to remove cocoa fat from starting cocoa beans.

Equipment

- Analytical Balance
- SFT-110 SFE Unit
- 100 cc Sample Vessel

Materials

- Chocolate Bars
- 100 cc Sample Vessel Bags
- SFT Collection Vials
- 1 SFT Vent Tube

Experimental Procedure

Weigh 35.0 grams of chocolate on an analytical balance and load into a 100 cc sample bag. Place the 100 cc nylon 5 micron sample bag into a 100 cc sample

Figure 1: SFT-110 SFE

pressure vessel (10kpsi, 200°C operation). Seal the vessel and set into a SFT-110 SFE unit. Position a pre-weighed SFT collection vial on the outlet of the restrictor valve flow line. Extract the sample according to the following parameters:

Extraction Parameters

One fraction of fat will be collected via multiple fifteen steps of static and dynamic flow.

Fraction 1: Chocolate Fat

- Pressure: 620.5 bars/9000 psi
- Oven Temperature: 80ºC
- Restrictor Temperature: 100ºC
- CO_2 Flow Rate:15 mL/min
- 15 Static Steps: 10 min/step
- 15 Dynamic Steps:15 min/step

Results

Fat fractions will be bright yellow color oil (*Figure 2*) and will cool into a light yellow solid. Starting samples will appear as dried cocoa powder (*Figure 3*). Four

Figure 2. Extracted Fat Fractions

dark chocolate samples were utilized: Cadbury Royal Dark Chocolate™, Dove Silky Smooth Dark Chocolate™, Hershey Pure Extra Dark Chocolate™, and Lindt 85% Extra Dark Chocolate™. At 9000 psi and 80ºC, final respective extraction percentages of total fat were: 97.90%, 98.26%, 95.48%, and 95.99%. Figure 3 (below) shows the percent rate of fat extraction.

Figure 3. Starting Material after Extraction

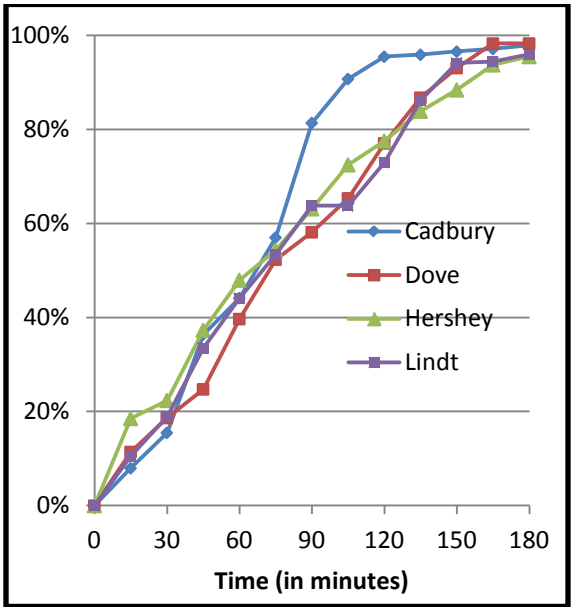

Figure 4. % Fat Extracted @ 9000 PSI

CONCLUSIONS

Chocolate bar fat can be extracted using the lab-scale SFT-110 SFE Unit. Supercritical CO_2 extraction can isolate the fat from the cocoa within final samples of chocolate permitting quality control checks within manufacturing conditions.

REFERENCES

James, Kenneth J., Ph.D. "New Advances in Supercritical Fluid Extraction for the Quality Control/Quality Assurance Laboratory for Fat Analysis." Supercritical Fluids, May 2004. Web. <http://www.supercriticalfluids.com/wp-content/uploads/TN-107-Fat-Analysis-with-the-SFT-100-SFE1.pdf